The Decay of ^{178}Tl

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A 90% enriched 1.02 mg/cm^2 target of ^{102}Pd was bombarded by a 340 MeV beam of ^{78}Kr ions at the 88-Inch Cyclotron to produce ^{178}Tl. This resulted in high yields of Hg isotopes, and also Au and Tl isotopes in lower yields. These reaction products were separated from the ^{78}Kr beam in the Berkeley Gas-filled Separator (BGS), passed through two parallel-plate avalanche counters (PPAC's) and were implanted into a position-sensitive silicon strip detector. Chains of known alpha decays observed from the same position on the detector shortly after implantation (<20 s) permitted the reaction products to be positively identified by comparing the energies of the alpha decays to values in the literature. By recording the time intervals between decays, half-lives were also deduced.

As shown in Fig. 1, approximately 1200 alpha decays were observed correlated to 6.544 MeV ^{174}Au alpha decays, or to the 6.038 MeV alpha particles of its beta-decay daughter, ^{174}Pt [1]. Four transitions, assigned to ^{178}Tl, are resolved, with energies of 6.616(15), 6.704(5), 6.785(5) and 6.859(5) MeV and relative intensities of 23%, 100%, 30% and 17%, respectively. The combined half-life of these transitions is 251(8) ms. The half-life of each of the individual transitions agrees with the combined half-life, so it is presumed that these are decays from the ground state of ^{178}Tl to different ^{174}Au states, rather then from ^{178}Tl isomers. If the 6.859 MeV decay procedes to the ^{174}Au ground state, the lower limit on the ^{178}Tl mass excess is –4.608(15) MeV.

Additional information was deduced by examining the entire ^{178}Tl decay chain. From the ratio of ^{178}Tl decays correlated to ^{174}Au vs. ^{174}Pt decays, a ^{174}Au alpha decay branch of 90(4)% was calculated. Gold-174 decays were found to be followed by 5815 keV decays, but not by the previously reported decays of its daughter, ^{170}Ir [1]. Based on the systematics of Ir isomers, the new transition is assigned to the ground state of ^{170}Ir, which implies a mass excess of –23.48(15) MeV.

Data for other nuclides were also analyzed. A 5.72 MeV transition, correlated to preceding 6.14 MeV ^{175}Au decays, was assigned to a new ground-state decay of ^{171}Ir, in analogy to the ^{174}Au-^{170}Ir case. Half-lives of an additional fifteen isotopes were also remeasured with improved precision relative to literature values [1]. This work has provided a wealth of information about very proton-rich nuclides in the region below the Z = 82 shell closure.

Footnotes and References

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1. R. D. Page, *et al.*, Phys. Rev. C **53**, 660 (1996), and references cited therein.

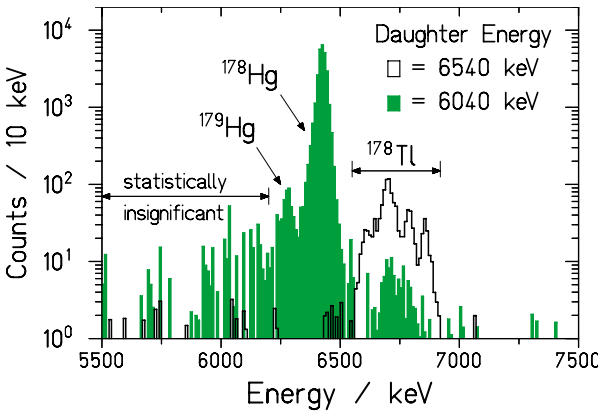

Fig. 1. Alpha decays correlated to either 6.54 MeV (unshaded) or 6.04 MeV alpha decays (shaded). The transitions between 6.6 and 6.9 MeV are assigned to ^{178}Tl. The peaks at 6.43 and 6.28 MeV (shaded spectrum) are from ^{178}Hg and ^{179}Hg decays correlated with known 6.04 MeV transitions in their daughters, ^{174}Pt and ^{175}Pt.